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ENTOMOLOGICAL SERIES, No. 23.

INSECTS ATTACKING CABBAGE AND ALLIED CROPS IN CONNECTICUT



FIG. 1. Cabbage Field showing damage by Cabbage Maggot.

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INSECTS ATTACKING CABBAGE AND ALLIED CROPS IN CONNECTICUT

By W. E. BRITTON AND QUINCY S. LOWRY.

The object of this bulletin is to place in the hands of vegetable growers a single publication giving information about the insects attacking cabbage, cauliflower, and allied plants in Connecticut. The subject matter is not entirely a compilation as the senior author has made observations on the insects in the state for many years, and for the past two seasons definite experimental work has been carried on by the junior author to control the cabbage root maggot.

CABBAGE ROOT MAGGOT: *Phorbia brassicæ* Bouché

The most important insect pest of early cabbages in Connecticut is the root maggot, which attacks not only cabbage, but also other allied plants such as cauliflower, turnip and radish.

This insect is a native of Europe, and was introduced into this country probably by accident, making its first appearance in Massachusetts more than seventy years ago. According to published statements it has now spread throughout the United States and Canada, and caused injury wherever its food plants are grown. Some entomologists, however, consider this questionable and regard another species, *P. fusciceps* Zett., which is a general feeder, as responsible for the injury in the Southern Atlantic states. Be this as it may, the insect surely causes severe damage in the northern and eastern states and seems to be on the increase, though Dr. J. Fletcher, as early as 1885, reported it as destroying from 25 to 75 per cent. of the cauliflower plants in Canada. The damage to early cabbages was especially serious in Connecticut in 1915. The maggots feed upon and tunnel in the main stem and larger roots just below the surface of the ground as shown in figure 2, greatly reducing the vitality of the plants and often causing them to wilt and die. Plants which have been moderately or severely injured will not recover and make satisfactory heads, even though the maggots are killed. This insect

seldom injures cabbages late in the season but often causes serious injury to turnips and radishes.

Description and Life History.—The maggots are the larvae of a small, two-winged fly which lays eggs on or near the stem of the plant, usually just beneath the surface of the ground late

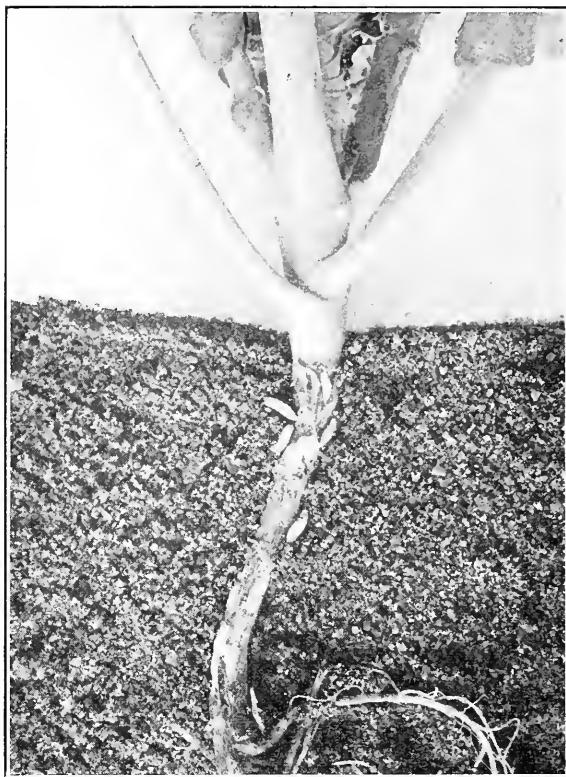


FIG. 2. Young Cabbage Plant showing Maggots on outside of Stem. Natural size.

in April or early in May. There are at least three and possibly four broods each year. The second brood appears about the middle of June, but it is only the first brood that seems to cause serious damage to cabbage and cauliflower crops.

Egg.—Pure white, oval, about 1 mm. or $1/25$ of an inch in length. Though eggs are deposited separately, each female

averages between 50 and 60 eggs. These eggs hatch in from three to five days according to climatic conditions.

Larva.—When fully grown the maggot is about 8 mm. or $1/3$ of an inch long and yellowish white in color. It has no legs and is quite helpless: if it hatches far from its food plant it is sure to perish. It cannot bite but its mouth-parts enable it to scrape away the tissues of the host plant, which soon begins to decay, thus making it easier for the maggots to penetrate. From three to four weeks are required for the maggot to reach maturity.

Pupa.—When mature the larva or maggot leaves its host plant, descends an inch or more into the soil and transforms to the pupa stage by utilizing its outer skin for a shell or puparium after the

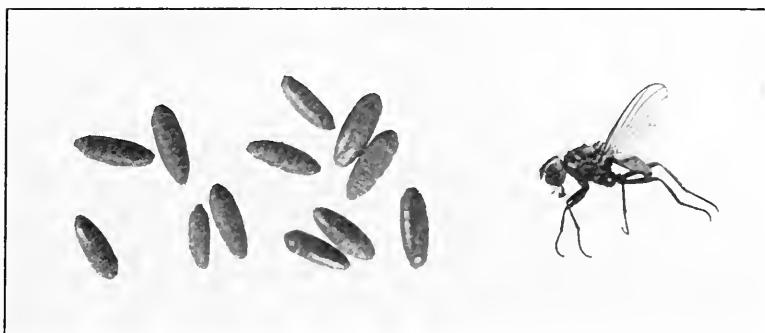


FIG. 3. Puparia and Adult of the Cabbage Maggot. Enlarged.

manner of flies. The brown pupae are abundant in Connecticut about the middle of June. This stage usually requires about two weeks, though with the late fall brood it lasts through the winter, the pupae being found as late as May 7th the following spring.

Adult.—The two-winged fly is gray with thorax and abdomen more or less irregularly marked with black. It somewhat resembles the common house fly, though smaller, and the female is lighter than the male and has fewer distinctive characters. The male has a tuft of bristles on the under side of each femur which distinguishes it from allied species. Adults are known to pass the winter in stubble in the field and in similar places where they can find protection. Adult and puparia are shown in figure 3.

Natural Enemies.—A number of predaceous and parasitic insects are known to attack the cabbage root maggot. A small

spider, *Trombidium*, sucks the eggs. Some of the rove beetles (family Staphylinidæ) devour large numbers of maggots. Several four-winged flies are known to be parasitic on the cabbage maggot, and in Minnesota a few years ago three new species, one a serphoidid, *Loxotropa pegomyiae* Brues, and two



FIG. 4. Plant Protected by Tarred Paper Disk.

ichneumonids, *Mesocrina pegomyiae* Brues and *Aphareta pegomyiae* Brues, were reared from the puparia.*

Control Methods.—The most effective and economic method of control is to place around the stem of each plant, soon after setting, a disk of tarred paper as shown in figure 4. These disks

* Report of Minnesota State Entomologist for 1907-1908, page 192.

may be purchased from Hirsch Bros., 2257 Metropolitan Ave., Middle Village, N. Y.; Smith Bros., Green Bay, Wis.; A. B. Cowles, 25 South Water St., Rochester, N. Y., or they can be cut at home as shown in figures 5 and 6.

In our experiments at the Station Farm, Mt. Carmel, in 1915, the insect was very abundant and caused a loss of 23.3 per cent. of the untreated plants, though close beside them where the tarred paper disks were applied there was a loss of only 4.4 per

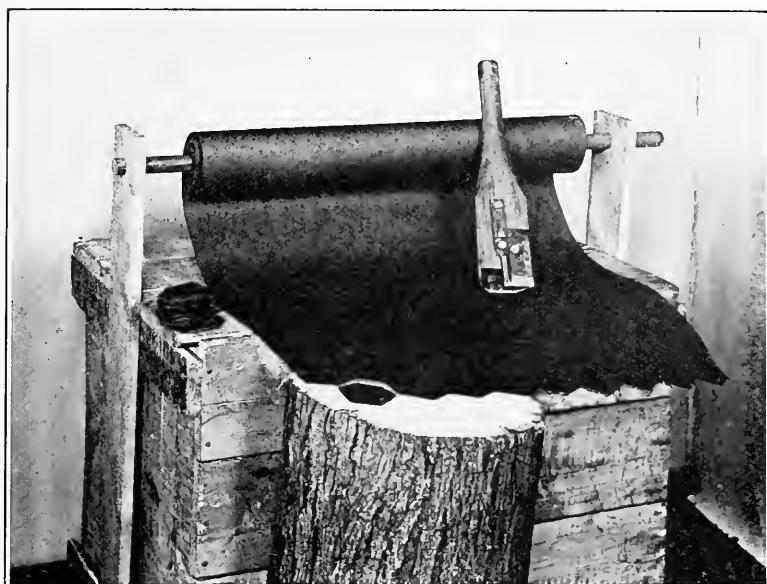


FIG. 5. Tool and Device for Cutting Disks.

cent. The carbolic acid emulsion treatment permitted a loss of only 6 per cent. The difference is shown in figure 7. Similar results have been obtained in preceding tests.

Perhaps the second most effective control method is to pour into a surface depression around the stem of each plant about three fluid ounces of crude carbolic acid emulsion made after the following formula:

Hard soap, 1 lb., or soft soap, 1 qt.

Boiling water, 1 gal.

Crude carbolic acid, 1 pt.

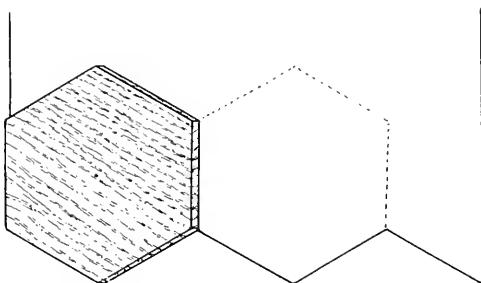


FIG. 6. Wood Form for cutting Hexagonal Disks.

Dissolve the soap in the boiling water, add the acid and churn as in making kerosene emulsion. This mixture thickens on cooling and should be diluted with 30 times its bulk of water before using.



FIG. 7. Plants at left were protected by Tarred Paper Disks; injury less than 5 per cent. Those at right were untreated; nearly one-third were injured.

Clean culture, destruction of infested stumps and other rubbish, and crop rotation are important practices in controlling the cabbage maggot.

THE IMPORTED CABBAGE WORM OR BUTTERFLY.

Pontia (Pieris) rapæ Linn.

This is the larva of the common white cabbage butterfly, a well-known European pest which was introduced into Canada about 1860, and has since spread nearly all over the United States, largely supplanting the native species. There are usually three annual generations in the north, and five or six in the



FIG. 8. Imported Cabbage Worms. Natural size.

southern states. The entire life cycle requires from three to five weeks. The larvae injure the plants by feeding on the outer leaves, often stripping them.

Description and Life History.—This is one of the first butterflies to appear in spring, and is often seen in Connecticut on warm days in March.

Egg.—Eggs are laid singly on the under side of the leaf of any available plant of the cabbage family (*Cruciferae*). They are fastened to the leaf by one end, and are about 1 mm. or one-

twenty-fifth of an inch in length, light yellow, bullet-shaped, sculptured with prominent longitudinal ridges and transverse striae. From 4 to 8 days are required for hatching.

Larva.—About 31 mm. or one and one-fourth inches long when full grown, velvety green, with a paler yellowish stripe along the back, and row of spots along each side. It moves sluggishly, and feeds ravenously on the outer or loose leaves. From ten to fourteen days are passed in this stage, which is shown in figure 8.

Pupa.—The pupa or chrysalis is about three-fourths of an inch long, at first pale green but later turning brown, marked with small black spots. It is suspended horizontally by silken threads, sometimes to its food plant, but often under fence rails, edges

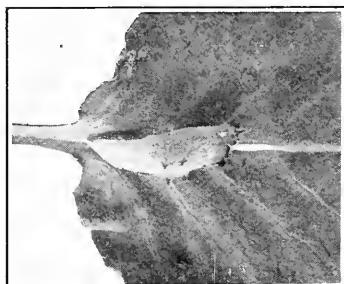


FIG. 9. Chrysalis of Imported Cabbage Butterfly. Natural size.

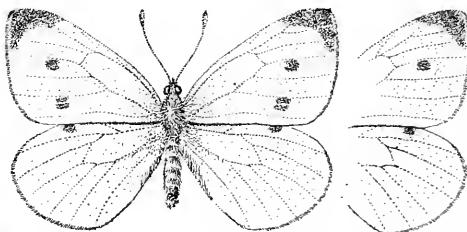


FIG. 10. Imported Cabbage Butterfly, Female at left. Natural size.

of clapboards and shingles on buildings, etc. With the early broods from seven to fourteen days is passed as a chrysalis, but the late fall brood passes the winter in this condition. Shown in figure 9.

Adult.—The butterfly has a wing-expanses of about two inches. Wings yellowish white, marked with black at the tips. The female has two circular black spots on each fore wing; the male has only one. Both sexes have a black spot on the anterior margin of the rear wing. Head, antennae and upper side of body are nearly black. Under side of body and legs are yellowish white. Shown in figure 10.

Natural Enemies.—A small four-winged fly or braconid, *Apanteles glomeratus* Linn., is the most common parasite and was

quite abundant at the Station field at Mt. Carmel in 1915. Another common parasite is a minute chalcid fly, *Pteromalus puparum* Linn. Various wasps, especially the common wasp, *Polistes pallipes* LeP., prey upon the larvae.

Control Methods.—Cabbage growers usually spray or dust their plants with lead arsenate and it is perfectly safe before the plants are headed. When nearly ready to harvest, it is advisable to dust the plants with insect powder (Pyrethrum) or some other fine dust applied with a blower or powder gun. Water heated to a temperature of 130° F. is said to kill all worms with which it comes in contact without injuring the plants.

THE POThIERB BUTTERFLY.

Pontia napi Linn.

This native species occurs in Canada and in the northeastern United States, and was formerly the common cabbage worm, but has now been almost entirely replaced in cabbage fields by the imported cabbage worm, *P. rapæ*. The larva resembles that of the imported cabbage worm but is about the same color as the cabbage leaf and usually feeds upon the under side, leaving a network of veins.

The adult does not appear as early in spring and its wings are nearly all white without the black spots. It now feeds chiefly on native vegetation.

The remedies used against the imported cabbage worm will also control this species.

THE SOUTHERN OR CHECKERED CABBAGE BUTTERFLY.

Pontia protodice Boisdv.

This butterfly is a native of the United States and is much more abundant in the southern states than in the north. Though adults are frequently seen and taken in Connecticut, we have not observed the larvae injuring cabbages here. Farther south this species was considered a serious pest of cabbage plants before the advent of the imported cabbage worm in the United States, the latter having largely replaced it as a pest.

The habits of this species and the control methods used against it are practically the same as given above for *P. rapæ*.

The egg and chrysalis are very similar to that species, but the larva differs in having two pale yellow stripes along each side.

The adult is also larger, the male resembling that of the imported cabbage worm but with additional spots on the fore wings, and the female is heavily marked with black on both front and rear wings, as shown in figure 11.

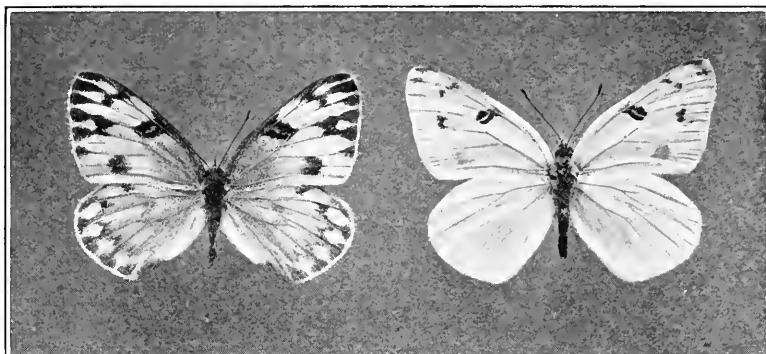


FIG. 11. The Southern or Checkered Cabbage Butterfly, Female at left.
Natural size.

THE CABBAGE LOOPER OR CABBAGE PLUSIA.

Autographa brassicæ Riley.

As a pest, the cabbage looper ranks next to the imported cabbage worm and in certain seasons in some localities may even do greater damage. The name comes from the looping habits of its larva, due to the absence of pro-legs on the third and fourth abdominal segments, as is the case with the measuring worms.

This insect is well distributed east of the Rocky Mountains, but is far more destructive in the southern states, though it is injurious in the north. In Connecticut there are at least two broods each year, while in Florida six broods have been recorded. The larva feeds on nearly all cruciferous plants and when abundant often injures other vegetables, and in late fall occasionally attacks plants in the greenhouse.

Description and Life History.—This insect does not appear as early in the season as the imported cabbage worm, and the larva may be recognized by its smooth skin, body tapering towards the head, its light green color and looping habit. Instead

of feeding wholly on the outer leaves, the larvae often go deep into the head.

Egg.—The egg is about the size of a mustard seed, convex and pale green, and is laid singly, usually on the upper, though occasionally on the under side of the leaf.

Larva.—The full grown larva is from one to one and three-eighths inches long, pale green, indistinctly and longitudinally striped with white. It is narrowest at the head and gradually broadens toward the distal extremity. The larval period varies from two to four weeks.



FIG. 12. Cabbage Looper, *A. brassicæ*, showing Adult, Larva, and Pupa Stages. Natural size. (After Chittenden, Bureau of Entomology, Bull. 33, U. S. D. A.)

Pupa.—The pupa or chrysalis is formed within a white silken cocoon on the leaves of the host plant. The duration of the pupal stage varies from one week in summer to three weeks in fall, and the last seasonal brood winters as a chrysalis.

Adult.—The adult is a noctuid moth with grayish brown fore-wings marked with white. It has a wing-expansile of about one and one-half inches and each fore wing is ornamented near the center with a silver dot and U-shaped mark. The rear wings are of lighter brown with darker scalloped margins.

Larva, pupa and adult moth are shown in figure 12.

Control Methods.—As a rule the methods employed against the other cabbage worms will control this species but on account of its habit of eating into the heads arsenical poisons should not be used on headed plants. The cabbage looper is apparently not as susceptible to dry powders as is the imported cabbage worm.

THE CABBAGE APHIS OR PLANT LOUSE.

Aphis brassicæ Linn.

The cabbage aphis is another serious pest brought to this country from Europe, probably on cabbage, and has since spread

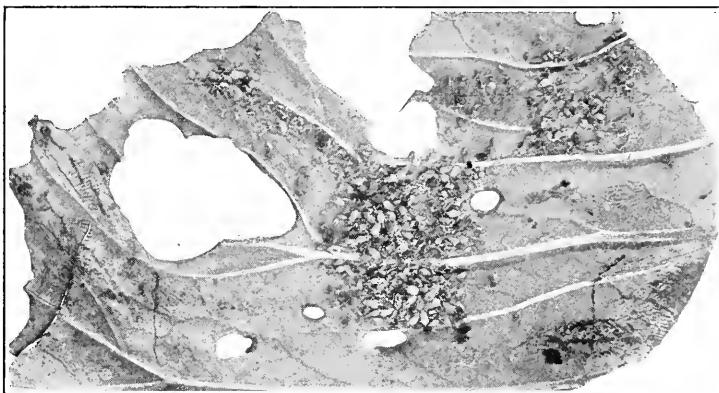


FIG. 13. Cabbage Aphis on Leaf. Natural size.

rapidly throughout the United States. It is present and usually abundant every year in Connecticut, though affected considerably by atmospheric conditions. It is usually found on the under side of the leaves where it sucks the sap, often causing great damage when abundant. It is even a more serious pest farther south.

Description and Life History.—This insect appears here in June, and like most plant lice, several generations of winged and wingless females are produced which bring forth living young. On the approach of cold weather a true sexual generation is produced and the females lay eggs to carry the species through the winter.

The young nymph is pale green with black legs and antennae. The mature forms are yellowish green with black head and eyes

and dark cornicles or honey tubes. Except for the wings, the winged and wingless forms resemble each other.

Instead of occurring individually on the leaves as is the case with some plant lice, the cabbage aphis usually occurs in large colonies, often covering considerable leaf surface on badly infested plants. The wax exudation gives the colony a bluish bloom and interferes somewhat with the application of insecticides. This insect is shown in figure 13.

Natural Enemies.—Lady beetles, chrysopid, and syrphid larvae, and many minute, four-winged parasitic flies help to hold the cabbage aphis in check.

Control Methods.—The nicotine solution known as "black leaf 40," one teaspoonful in a gallon of water, with a little soap added, and sprayed upon the plants, proved effective and satisfactory in destroying this aphid in our experiments at Mt. Carmel. On account of the wax secretion, it is necessary to add the soap. Any mixture of tobacco and laundry or whale-oil soap, or even the soap alone, will probably prove successful if it contains at least one pound of soap to eight gallons of water. In any attempt to control sucking insects it is imperative that the mixture come in direct contact with their bodies. Even a forceful stream of water from a hose has often been used to advantage in disposing of aphids on cabbage plants and may also prove a satisfactory method of getting rid of some of the other cabbage insects.

THE CABBAGE PLUTELLA.

Plutella maculipennis Curt.

Though not usually a serious pest, at times the cabbage plutella causes considerable damage to the cabbage crop by eating small holes through the outer leaves. The larvae are quite small and may easily be mistaken for young cabbage worms: in fact, most growers regard them as the young larvae of some other insect, and the identity of the cabbage plutella is thus often overlooked.

Description and Life History.—The larvae are generally more abundant in a dry season than in a wet one, and there are two or three annual generations in this part of the country, but we have not studied its life history in Connecticut.

Egg.—The egg is white, very small and generally attached to the leaves.

Larva.—Pale green and only about one-fourth of an inch long when full grown. Very active, and when disturbed wriggles and drops to the ground.

Pupa.—Enclosed in a whitish open-work net, usually attached to the leaves. It hibernates in this form.

Adult.—A small tineid moth having a wing-expanses of five-eighths of an inch, the general color being ash-gray with light clay-yellow rear margins on the fore wings.

Control Methods.—The measures for controlling the imported cabbage worm will also hold this insect in check.

THE ZEBRA CATERPILLAR.

Mamestra picta Harr.

The zebra caterpillar is a very common pest in the garden, attacking nearly all kinds of vegetables as well as flowering plants, and is the first insect recorded in this country as feeding on the beet. As a rule, in Connecticut its damage is not serious or widespread.

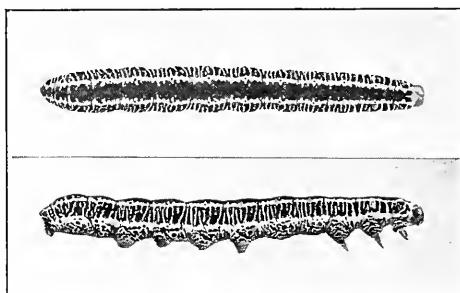


FIG. 14. Zebra Caterpillar, showing dorsal and lateral views. Natural size.

Description and Life History.—A smooth caterpillar about two inches long when full-grown, and black or dark brown strikingly marked with yellow, as shown in figure 14. Its head is orange or reddish yellow. The young caterpillars feed in clusters and may easily be destroyed by hand.

Adult.—The adult is a noctuid moth, having a wing-expanses of one and one-half inches, appearing in June. The fore wings

and thorax are reddish brown without prominent markings. The rear wings are nearly white, margined with light brown.

Control Methods.—Spraying with arsenical poisons will control this insect.

The imported cabbage web-worm, *Hellula undalis* Fabr., and the cross-striped cabbage worm, *Evergestis rimosalis* Guen., both injure cabbage plants in the southern states but are not known to occur in Connecticut. The remedies used against the other cabbage worms will control them.

THE HARLEQUIN CABBAGE BUG.

Murgantia histrionica Hahn.

The Harlequin cabbage bug is a native of Mexico and Central America and migrated into Texas about 1864 and has gradually spread toward the northeast. It is a serious cabbage pest in the southern states and even as far north as southern New Jersey. In 1894 it was quite abundant on Long Island but Mr. F. A. Sirrine writes that it has not been common there since; and that he has not seen a specimen for several years. The only specimen thus far recorded from Connecticut is now in the Station Collection, and was collected at Meriden, July 4, 1910, by Mr. Harry L. Johnson. It will probably never cause serious damage in Connecticut but it is mentioned here so that Connecticut growers may recognize it if it appears in the State. This insect is also called "Calico Back," "Calico Bug," "Terrapin Bug," and "Fire-Bug." It injures the plants by sucking out the sap.

Description and Life History.—The eggs are barrel-shaped and are usually deposited in two rows, with one end of each egg fastened to the under side of the leaf. They are green at first but soon change to white with black markings. Only two or three days are required for hatching in the southern states.

The nymphs are generally oval and somewhat flattened. The young are glossy yellow, but as they develop become black with reddish yellow markings. In about two weeks they become mature.

The adult resembles the nymph but has wings, and is black and orange-yellow and marked as shown in figure 15. In the

northern states the adults hibernate in rubbish where they can find protection, but in the south they may be found feeding upon cabbage plants at any time during the winter.

Control Methods.—This “bug” is especially difficult to control. In places where it hibernates all rubbish should be removed from the field in the fall, that would furnish a place of shelter. Hand picking in the early spring is also effective.

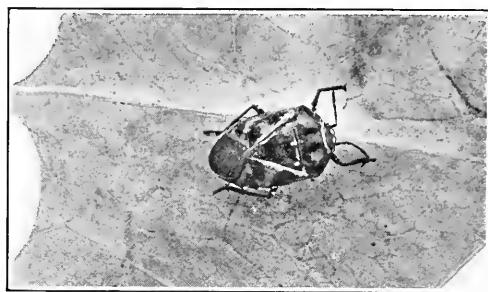


FIG. 15. Harlequin Cabbage Bug. Twice natural size.

The cabbage flea beetle, *Phyllotreta vittata* Fabr., which occurs in Connecticut, and the cabbage curculio, *Ceutorhynchus rapæ* Gyll., which has not been recorded from the state, are both common in New Jersey and feed on cabbage and allied plants. If they should appear in destructive numbers in Connecticut, a spray of lead arsenate will probably serve to control both insects.

CUT-WORMS.

At the Station farm in Mt. Carmel in 1915 considerable damage to cabbage plants was caused by cut-worms. Many plants were cut off just above the surface of the ground as shown in figure 16, only a few days after the plants were set.

Ordinarily cut-worms feed on grasses and are not seriously injurious, but when the field in which they are located is cultivated, in the absence of their natural food they attack the cultivated crop. There are several species of cut-worms causing similar damage, but the most injury is done by the common ones and the remedy is practically the same for all species. These cut-worms are the larvae of moths belonging to the family Noctuidae. The majority collected this season were the so-called “well-marked cut-worm,” *Noctua clandestina* Harris.

The "worms" feed at night, usually cutting off the stem of the plant just above the ground, and go into the ground to hide during the day. When full grown, in the late spring, they are of a dark brown and blackish color, with stripes running longitudinally. Usually there is only one generation each year.



FIG. 16. Cut-worm and severed Cabbage Plant.
Natural size.

The most effective control method used this season was in the form of a sweetened poisoned bran mash. The formula used was that recommended for the controlling of grasshoppers in Kansas, and is as follows:

Bran mash	$\frac{1}{2}$ bushel
Paris green	1 pound
Lemons	3
Molasses	2 quarts
Water	$3\frac{1}{2}$ gallons

Mix the Paris green (dry) with the bran thoroughly. Squeeze the juice of the lemons into the water and cut up pulp and rind into fine pieces and mix together. Then pour in the molasses and stir. This mixture is then added slowly to the poisoned bran mash and when complete is rather dry and easy to handle. This should be applied by scattering it broadcast in the late

afternoon, if possible before the plants are set, so that it will be moist when the "worms" start to feed in the early evening. Experiments have shown that the use of lemons was 40 per cent. more effective than the use of oranges. Paris green was also found to be more effective than arsenate of lead.

Early spring plowing and harrowing will tend to greatly reduce the number of these "worms." Trap crops are sometimes used. "Trap crops are those which are planted as a bait or lure to attract the early insects so that they may be destroyed upon them before the crop to be protected is available."

WIRE-WORMS.

Wire-worms are hard, shiny, slender, light brown larvae about three-quarters to one inch in length, which often bore into the stems and roots of many field and garden crops. They belong to the family Elateridae, commonly known as "click-beetles" or "snapping beetles," and generally breed in sod ground. These worms usually feed on the roots of grasses and native plants and are seldom noticed. When such ground is cultivated and planted with vegetables, the worms do not have the grass roots on which to feed and at once attack the cultivated crop. As it takes from three to five years for these insects to complete their life cycle, they are a difficult pest to control. The past season there were a great many wire-worms present at Wethersfield, Connecticut, and entirely ruined a crop of early cabbage at Fair View Farm, belonging to Mr. W. G. Griswold. This form of injury is shown in figure 17. At the Station farm at Mt. Carmel they did considerable damage to lettuce planted on new ground. There is no solution that can be applied strong enough to kill the worms without injuring the plants. Rotation of crops is recommended and also the placing of a catch-crop.

CABBAGE SNAKES.

There are no true snakes which infest cabbages, but the name "cabbage snake" is applied to a species of *Mermis* which is really a long, slender, cylindrical worm, commonly known as a "hair worm" or "hair snake." These worms are parasitic in the bodies of a number of insects and are often found coiled up in the soil. Occasionally one is found in a cabbage head, and

is made the subject of a startling newspaper story. Such worms will neither injure cabbages nor persons eating cabbages.



FIG. 17. Wire-worms and Cabbage Plants injured by them.
Natural size.

One of the "thousand legs" (*Geophilus bipuncticeps*) is also found in the heads of cabbages and is also called a "cabbage snake." It is a blind, earth-inhabiting animal, is neither a snake nor an insect, and like the "hair worm" is not harmful to cabbages or human beings.

CULTURAL PRACTICES.

Truck crops in general are peculiarly susceptible to insect attack, there being a total loss of 20 per cent. of their total value due to the ravages of insects. As many insects feed only on one crop, it is absolutely essential that the crops be rotated. For example, the cabbage root maggot hibernates in or near the field where cabbage has been grown, and if that same field is planted to cabbage the next spring, food for this insect will be abundant. The result will be a probable increase of the pest. Crops such as cabbage, radish, cauliflower, etc., which are closely related, should be avoided in crop rotation as insects generally feed on closely related plants.

Cabbage stumps, leaves, etc., should not be allowed to remain in the rows, but should be removed from the field and destroyed or plowed under as soon as possible after the crop is harvested. If this is not done, it leaves a hibernating place for insects.

Late fall plowing destroys a great many insects while hibernating. Different insects pass the winter in different stages of development. Cut-worms pass the winter in the soil as larvae, while click-beetles hibernate as newly-formed beetles. Cut-worms may be greatly reduced in numbers by early spring plowing and harrowing, which will crush them or starve them out before the crop is planted.

LITERATURE.

The following is a short list of the more important publications treating of insects injurious to cabbages:

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